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WATER SUPPLY AND WATER QUALITY CONTROL STUDY, PLAQUEMINE LOCK, LOUISIANA. STUDY OF NEEDS AND VALUE OF STORAGE FOR MUNICIPAL AND INDUSTRIAL WATER SUPPLY AND WATER QUALITY CONTROL

Public Health Service
Dallas, Texas

June 1965

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WATER SUPPLY
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WATER QUALITY CONTROL STUDY
PLAQUEMINE LOCK, LOUISIANA

Study of Needs and Value of
Storage for Municipal and Industrial
Water Supply and Water Quality Control

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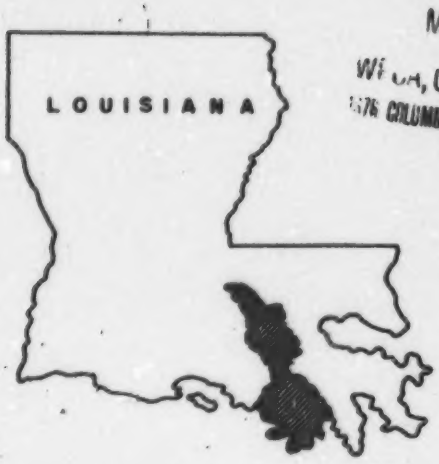

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Public Health Service, Region VII
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WATER SUPPLY

AND

WATER QUALITY CONTROL STUDY

PLAQUEMINE LOCK, LOUISIANA

Abstract

An investigation has been carried out which discloses and evaluates an immediate and future need for water supply for municipal and industrial purposes which may be served by diversion of Mississippi River water to the Intracoastal Waterway-Port Allen to Morgan City Route. Economic and demographic studies revealed a potential for increased industrial development and population growth, and serve as the foundation for projected needs.

Prepared for

DEPARTMENT OF THE ARMY

U.S. Army Engineer District

New Orleans, Louisiana

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VII
Dallas, Texas

JUNE 1965

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I. INTRODUCTION

Request and Authority

The Corps of Engineers, New Orleans District, in a letter dated June 15, 1964, requested the Public Health Service ". . . to make a study of the need for water from the Mississippi River in the area between the East Atchafalaya basin protection levee and Bayou Lafourche and the benefits of supplying these needs. . . ." 1/

Purpose and Scope

The purpose of this study is the determination of the need for and value of diversion of water from the Mississippi River to the Intracoastal Waterway, Port Allen to Morgan City Route, with special emphasis on the needs for municipal, industrial, and pollution control purposes through the year 2020 in the three southernmost parishes located between Bayou Lafourche and the East Atchafalaya basin protection levee, together with Morgan City, Louisiana.

Acknowledgments

The assistance and cooperation of agencies and individuals who provided data for this report are gratefully acknowledged. These include:

Geological Survey
Fish and Wildlife Service
Louisiana State Board of Health
Louisiana Stream Control Commission
Louisiana Department of Public Works
Corps of Engineers, New Orleans District
Water utilities and municipal officials at
Plaquemine and Houma, Louisiana

II. SUMMARY OF FINDINGS AND CONCLUSIONS

Summary of Findings

1. The U.S. Army Corps of Engineers is studying Plaquemine Lock, Plaquemine, Louisiana, with the view of determining whether it should be modified at this time for diversion of fresh water from the Mississippi River via Bayou Plaquemine to Intracoastal Waterway-Port Allen-Morgan City Route.

2. Water diverted from the Mississippi River through Plaquemine Lock is of a quality suitable for general municipal and industrial use.

3. At present, the quantity of water passing down the Intracoastal Waterway in the Port Allen-Morgan City Route is controlled by lockage at Port Allen from the Mississippi River and at Bayou Sorrel from the Atchafalaya River.

4. The 3-parish study area, 1960 population 108,701, consists of Iberville, Assumption, and Terrebonne Parishes, together with Morgan City, 1960 population 13,540. The terrain of these parishes, which lie east of the Atchafalaya Basin Floodway and southwest of the Mississippi River, is extremely flat, marshy, and interlaced by a multitude of poorly defined streams and waterways. Principal communities are Plaquemine (Iberville Parish), Houma (Terrebonne Parish), and Morgan City (Saint Mary Parish).

5. Food and kindred products industry is the major manufacturing employer in the study area, while chemicals and allied products, together with lumber and wood products, leads in the Plaquemine area. Mining (associated with petroleum production) is the leading basic employer in Terrebonne Parish.

6. Bayou Black, present source of water supply for Terrebonne Parish, is of unsuitable quality for general municipal and industrial use for extended periods of time due to high dissolved solids and chlorides concentration.

Conclusions

1. Based upon projected 2020 levels of industrial production and a population of 320,000, water requirements in the 3-parish study area for municipal and industrial purposes will total 5.4 billion gallons daily (bgd) of which 690 million gallons per day (mgd) will need to be of a quality equivalent to that described as acceptable in the Public Health Service Drinking Water Standards. The remaining portion will be used for industrial cooling purposes and need not be of such high quality. Morgan City will require 26.1 mgd of high quality municipal and industrial water supply to serve a projected 2020 population of 40,000 individuals.

2. The Mississippi River, Atchafalaya River, and/or ground water are readily available sources of water supply for that part of the study area adjoining these rivers, while the Atchafalaya River serves as a ready source of supply for Morgan City. The remaining portion of the study area, particularly Terrebonne Parish, could benefit by diversion of fresh water to provide a consistently suitable source of supply.

3. Projected 2020 municipal and industrial water supply needs for the Terrebonne Parish part of the study area amount to approximately 860 mgd, of which 129 mgd will need to be of high quality suitable for municipal and industrial process use. The 731 mgd remaining would be used for industrial cooling purposes. Existing sources of supply are of suitable quality and adequate quantity for this future cooling use.

4. Based upon the cost of the most likely alternative in the absence of diversion to this area, the 1970 worth of providing water of high quality suitable for municipal and industrial process use is $148,700 annually.

5. Provision of adequate treatment and disposal of wastes in the Bayou Plaquemine area obviates flow regulation to control water quality between Plaquemine Lock and the Port Allen-Morgan City Intracoastal Waterway Route.

6. Diversions of Mississippi River water at Port Allen Lock will be of better quality than at Plaquemine Lock, since the latter diversion point is downstream from waste releases from the Baton Rouge metropolitan area and industrial complex and there is no intervening runoff area.

III. DESCRIPTION OF PROJECT

Location and Features

Bayou Plaquemine Lock is located on the right bank of the Mississippi River, about 208 miles above the Head of the Passes, nominal mouth of the Mississippi. The lock was a feature of the Morgan City-Plaquemine Alternate Route of the Gulf-Intracoastal Waterway shown on figure III-1 (located at the back of this report). It has become surplus to present and projected navigation needs as a result of extension of the waterway to a new connection with the Mississippi River at Port Allen, Louisiana. The remaining traffic through the lock is not sufficient to justify operation, and it has been proposed that the lock be abandoned and a levee constructed across the river entrance. 2/

Consideration is also being given to modification of the lock structure to permit diversion of water from the Mississippi River to the Intracoastal Waterway via Bayou Plaquemine.

Streamflow

The area between the East Atchafalaya basin protection levee and Bayou Lafourche is drained by numerous streams and canals, but is so flat that drainage basins are poorly defined. From Bayou Sorrel Lock south to the Intracoastal Waterway, practically no flow pattern is distinguishable. South of the Intracoastal Waterway in Terrebonne Parish, the area is best described as a tidal marsh.

Flow in the Port Allen-Morgan City Route of the Intracoastal Waterway is contributed by runoff from the area and diversions from the Mississippi at Port Allen Lock and the Atchafalaya River at Bayou Sorrel Lock. No flow records are available for this canal. Studies by the Louisiana Department of Public Works indicate that up to 3,000 cubic feet per second (cfs) could be diverted to the upper portion (landside) of the route without causing flooding. 2/

Water Quality

Only meager water quality data are available for the Port Allen-Morgan City Route in the vicinity of Plaquemine and Indian Village. These data are appended. Waters diverted to the Intracoastal Waterway at Plaquemine Lock will be of good quality, essentially the same as that shown for the Mississippi River at Saint Francisville and New Orleans, Louisiana. See table A-1 in Appendix A. Water diverted to Intracoastal Waterway (landside) at Bayou Sorrel Lock is of good quality, essentially that shown in table A-2 of Appendix A.

IV. DESCRIPTION OF THE STUDY AREA

Location and Boundaries

The area considered in evaluation of the needs for diversion at Plaquemine Lock consists of three parishes, Iberville, Assumption, and Terrebonne, adjoining the Intracoastal Waterway into which the diversion would be made. In addition to the 3-parish study area, the needs of the Morgan City area of Saint Mary Parish as contained in our Water Resources Study, Bayou Teche and Vermilion River, Louisiana dated July 1963 3/ have been included. The area is located in south-central Louisiana, lying between the East Atchafalaya basin protection levee on the west and Bayou Lafourche on the east. In general, the area is at a lower elevation than either the Mississippi or Atchafalaya Rivers.

Geography

The terrain of the area under consideration is extremely flat, marshy, and interlaced with many poorly defined streams. The soils of the area are very fertile and particularly suitable for the growth of sugarcane.

Climate

The climate is temperate, with hot summers and mild winters. The mean annual temperature is about 69°F. Mean annual precipitation in the area is approximately 61 inches. The average length of the growing season is approximately 260 days.

Principal Communities

Principal communities within the area studied are Plaquemine, Iberville Parish; Napoleonville, Assumption Parish; Houma, Terrebonne Parish; and Morgan City, Saint Mary Parish.

V. WATER RESOURCES OF THE STUDY AREA

Quantity of Water Available

The study area has abundant water resources, being located in a high rainfall region bounded, in part, by the Mississippi River and the Atchafalaya River. (However, there is no natural drainage toward the Mississippi or Atchafalaya Rivers due to the levee system in the lower Mississippi River basin.) The Mississippi River in the reach adjoining the northeast side of the study area has an average annual discharge of 467,200 cfs, while the Atchafalaya on the west side has an average annual discharge of 188,700 cfs. Thus, the quantity of water available does not present a problem.

Quality of Water Available

In the Houma area of Terrebonne Parish, chloride and dissolved solids concentrations in the municipal water supply often cause an unsatisfactory quality condition. A summary of the chemical quality of the municipal water supply of Terrebonne Parish in recent years is appended (table A-3). The high chlorides and dissolved solids concentrations result from salt water intrusion from the Gulf of Mexico entering the Intracoastal Waterway through the Houma Navigation Canal. Other streams in the area, such as Bayou Black and Bayou Terrebonne, are similarly affected. Appended tables A-4 and A-5 provide an indication of water quality in the latter streams.

The Atchafalaya River at Morgan City is of good to excellent chemical quality, see table A-6 in the Appendix. However, during November of 1963, chlorides concentrations were increased to nearly 1,500 mg/l for several days, returning finally to normal of less than 100 mg/l (Cl^-). The degradation resulted from peculiar tide, river discharges, and wind conditions at Morgan City.

All surface water of local origin in the area is highly colored, having been in contact for long periods with decaying vegetation in the marshes of the area.

Ground water is available in the northern portion of the study area but not in sufficient quantity to serve heavy water users. In the Houma and Morgan City areas, ground waters are affected by salt water intrusion.

VI. THE ECONOMY

An economic appraisal was made of the area located between the East Atchafalaya basin protection levee and Bayou Lafourche that could be affected by the Plaquemine Lock diversion. The resulting projections serve as a basis for estimating future municipal and industrial water requirements and waste discharges. The Morgan City area water needs and associated economic and demographic findings were extracted from a previous Public Health Service study entitled Water Resources Study, Bayou Teche and Vermilion River, Louisiana dated July 1963. 3/ The details are recounted here only as required.

Present

Employment

Table VI-1 shows employment patterns for the 3-parish study area for 1940, 1950, and 1960. Most significant labor force changes are the 67 percent decrease in agricultural employment and the 256 percent increase in mining employment over the period. Although agriculture lost 7,678 workers during this period, gains in mining, manufacturing, and service employment resulted in an increase of 4,623 workers in the labor force.

Table VI-1

Study Area Employment 1940, 1950, and 1960

	1940		1950		1960	
	Number	Percent	Number	Percent	Number	Percent
Agriculture, Forestry and Fisheries	11,535	41.6	7,612	28.7	3,857	11.9
Mining	1,120	4.0	2,099	7.9	3,988	12.4
Manufacturing	2,569	9.3	3,435	12.9	4,050	12.5
Food & Kindred Products	1,204	4.3	1,896	7.1	2,133	6.6
Machinery, except Electrical	78	.3	443	1.7	431	1.3
Chemical & Allied Products	28	.1	119	.4	370	1.1
Furniture, Lumber & Wood Products	876	3.2	640	2.4	284	.9
Other Manufacturing	383	1.4	337	1.3	832	2.6
Service & Other	8,846	31.9	11,974	45.2	17,980	55.6
Unemployed	3,632	13.2	1,400	5.3	2,450	7.6
Total Labor Force	27,702	100.0	26,520	100.0	32,325	100.0

Source: Bureau of the Census 4/

Agriculture

Despite its employment losses, agriculture is still a very important income-producing industry in the study area. This is reflected both in the value of agricultural output and in output from agriculturally oriented industry. Table VI-2 shows agricultural statistics for the period 1944-1959. Crops accounted for 88 percent of the total value of farm products sold in 1959. Most of the crop values result from production of sugarcane, which accounted for well over half the acreage of cropland harvested in the area. In 1963, 2,611,896 tons of sugarcane were harvested from 87,770 acres in the study area.* This amount represents 30 percent of Louisiana's sugarcane production. Parishes surrounding the study area contain sugarcane acreages of approximately 180,000 acres. Other crops of importance include corn and soybeans.

Table VI-2

Agricultural Statistics for the Study Area
1944 - 1959

	1944	1949	1954	1959
Number of Farms	1,705	1,816	1,539	1,109
Acres of Cropland Harvested	132,931	117,316	148,205	130,039
Value of All Crops Sold*	8,077	9,345	9,785	10,210
Value of All Livestock and Livestock Products Sold*	580	1,327	1,149	1,336
Total Value of All Farm Products Sold*	8,657	10,672	10,934	11,546

*All values in 1,000's of 1960 dollars.

Source: Bureau of the Census 5/

Mineral Production

The value of minerals produced in the study area exceeded 300 million dollars in 1962, as shown in table VI-3. This amount represented more than a three-fold increase since 1953. This increase is a result of oil and gas discoveries in the study area and offshore areas adjoining the study area. Over 80 percent of the

*Provided by Louisiana Agricultural Stabilization and Conservation Service.

1962 mineral production occurred in Terrebonne Parish. 3/ In addition to petroleum and petroleum products, sulphur and salt are commercially extracted in the study area. Mining employment in 1960 accounted for 12.4 percent of the total labor force in the study area, compared to 3.3 percent for the State of Louisiana.

Table VI-3

Value of Mineral Production in the Study Area
1953 - 1962

Year	Value*	Year	Value*
1953	97,231	1958	170,637
1954	98,480	1959	200,296
1955	116,921	1960	246,085
1956	123,606	1961	277,272
1957	152,503	1962	312,718

*All values in 1,000's of 1960 dollars.

Source: Bureau of Mines 6/

Manufacturing

As shown in table VI-4, value added by manufacturing in the study area increased 140 percent between 1939 and 1958. Food and kindred products employment accounted for over half the manufacturing employment in the study area, compared to less than 20 percent for the State of Louisiana. (See table VI-1.) The largest segment of food and kindred products processing is the manufacture and refining of sugar. There are 8 sugar factories located in the study area, with combined capacities to process 19,600 tons of sugarcane per day. The two sugar refineries in the study area have a combined capacity to refine 2.5 million pounds of raw sugar per day. 7/ Other significant food and kindred products processing in the study area includes canned or fresh and frozen seafoods. Chemical production is located mainly in the upper portion of the study area. Other significant manufacturing activities in the study area include printing, fabricated metals, machinery, primary metals, lumber and wood products, and furniture.

Table VI-4

Manufacturing Activity in the Study Area
1939 - 1958

Year	Number of Establishments	Value Added*
1939	74	9,883
1947	94	16,748
1954	98	21,920
1958	101	23,746

*All values in 1,000's of 1960 dollars.

Source: Bureau of the Census 8/

Population

As shown in table VI-5 and figure VI-1, study area population growth has been predominantly upward since 1930. Between 1930 and 1960, study area population increased at an average annual compound rate of 1.45 percent. Between 1950 and 1960, study area population increased at an average annual rate of 2.25 percent. The rural component of the population also increased during this time. Rural population growth was mainly caused by growth of small nonurban towns and villages located near urban areas.

Table VI-5

Population - Urban, Rural, and Total
for the Study Area, 1920 - 1960

	1920	1930	1940	1950	1960
Urban	9,792	11,655	14,101	22,061	39,329
Rural	61,900	58,699	68,041	65,295	69,372
Total	71,692	70,354	82,142	87,356	108,701

Source: Bureau of the Census 9/

Future

Future growth of the study area will be determined by the study area's ability to compete with other areas in the United States in the production of goods and services. Most of the industrial growth will be in those industries already demonstrating their competitive advantage in the production of their respective products.

These industries are food and kindred products, chemical and allied products, machinery, and other manufacturing normally associated with urban growth.

Agricultural production in the study area is expected to continue to center around sugarcane. According to a recent study of the Department of Agriculture, 10/ if gross returns from the production of sugarcane remained at the 1959 level, there would be a 40 percent increase in mainland sugar production by 1970. The only restriction the study area has in expanding its cane production is in the number of acres of cropland. According to the Louisiana Soil and Water Conservation Needs Inventory, 143,000 acres should be in cropland in the study area by 1975, an increase of 13,000 acres over 1959. 11/ One hundred and twenty thousand of these acres are expected to be devoted to the production of sugarcane by the year 2020. With increased use of insecticides, fertilizers, and better management, 2020 yields should be about 20 percent above yields presently being experienced in the study area. Based on these assumptions, 2020 sugarcane production in the study area should be approximately 4.8 million tons. With expected mechanization and improved efficiency in agricultural production, 2020 levels of production can be sustained, utilizing fewer workers than those presently being used. Agricultural labor force is projected for 2020 at approximately 3,000 workers. (See table VI-6.)

Mining

Continued increases in oil and gas discoveries and extraction are expected in the study area. Most of this increased production is expected in the gulf coast and offshore regions of the area. Mining employment is projected at 6,000 workers in the year 2020, a 50 percent increase over 1960.

Manufacturing

Manufacturing activity in the study area is expected to continue in growth of industries presently located in the study area. Industrial growth is expected to be centered around food and kindred products processing, chemical production, machinery, and other industries normally associated with urban and industrial growth complexes. Food and kindred products processing will occur in sugarcane factories, sugar refining, processing of seafoods, and those industries normally associated with urban growth, such as bakeries, dairies, etc. Sugarcane factories are expected to increase their capacities to 35,000 tons per 24-hour day. Sugarcane refining capacity is expected to be 4.5 million pounds per day of raw sugar. This growth is expected to occur in the gulf coast portion of the study area where it is presently located. With the gulf coast location for seafoods processing and excellent transportation facilities for marketing of processed seafoods, the study area should

continue to increase its output of these products. Output from seafood processors should increase about four-fold over present levels of production. With the vast quantities of petroleum resources available, especially in the gulf coast portion of the study area, plus available water transportation and an expanding national and regional market for its products, the outlook for chemical production in the study area is very optimistic. According to Resources for the Future's medium projection, 12/ national requirements for petroleum-based intermediates used in the manufacture of synthetics will increase eight-fold between 1960 and 2000. Because of good access to inputs and markets, the study area is expected to increase its petrochemical output fifteen-fold by 2020, with a part of the expansion occurring in Terrebonne Parish. Study area employment in chemicals and allied products is expected to be 5,000. (See table VI-6.) With the existing water transportation, available labor, and good access to regional and national markets, machinery manufacturing is expected to continue to increase. Employment in the machinery industry in 2020 is expected to be 3,000 workers. Employment in service industries is projected to move toward the level now experienced in the State of Louisiana, which is 69 percent of the total labor force. Some 77,500 workers are expected to be employed in the service and other category. Table VI-6 summarizes employment projections.

Table VI-6

Employment Projections for the Study Area - 2020

	1960		2020	
	Number	Percent	Number	Percent
Agriculture, Forestry & Fisheries	3,857	11.9	3,000	2.7
Mining	3,988	12.4	6,000	5.4
Manufacturing	4,050	12.5	21,000	18.8
Food & Kindred Prod.	2,133	6.6	8,000	7.1
Chemical & Allied Prod.	370	1.1	5,000	4.5
Machinery except Elect.	431	1.3	3,000	2.7
Other Manufacturing	1,116	3.5	5,000	4.5
Service & Other	17,980	55.6	77,500	69.1
Unemployed	2,450	7.6	4,500	4.0
Total Labor Force	32,325	100.0	112,000	100.0

Population

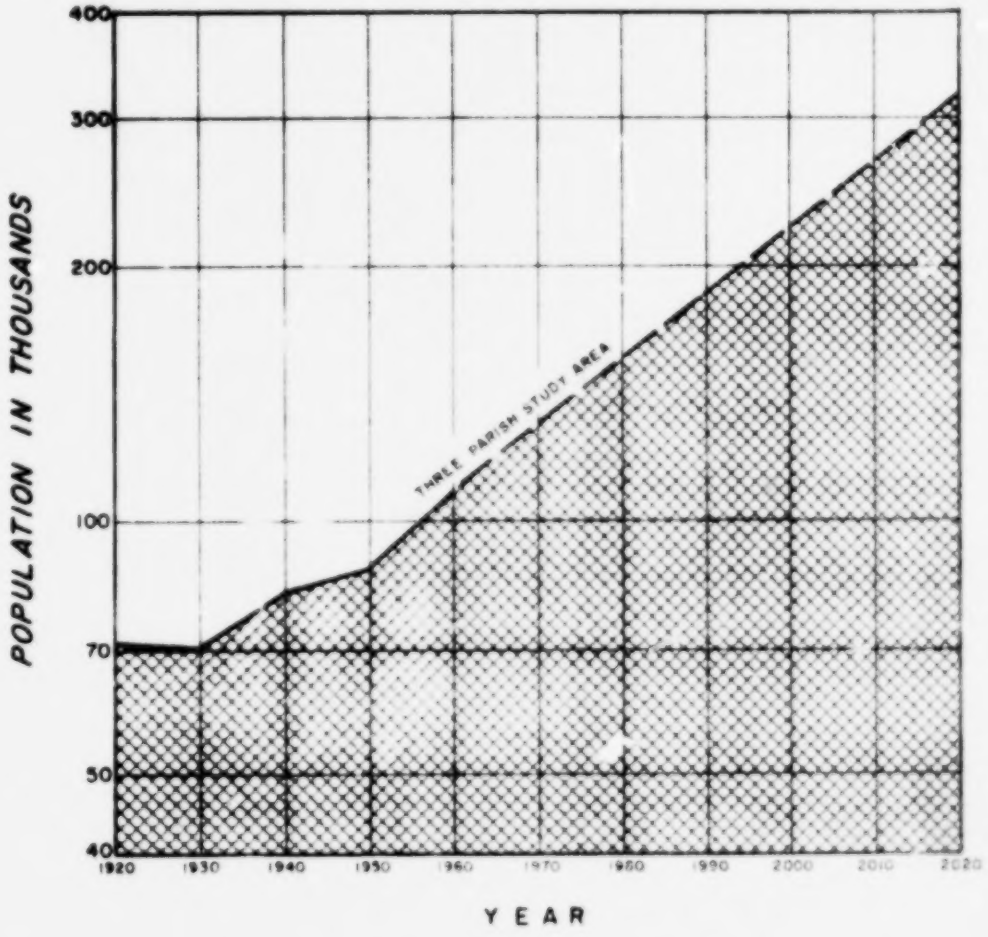
On the basis of the analyses of employment and production previously described, the total population of the three-parish study area is expected to increase to 320,000 in 2020, as shown in table VI-7 and figure VI-1.

To facilitate determination of water requirements for those areas to be affected by the diversion, population projections were allocated to each of the three parishes in the study area. These projections also appear in table VI-7. Since virtually all the populations are supplied by one water supply system for each of the parishes, no allocation of projections was made for urban or rural population. A graphic presentation of population projections for the three-parish study area is shown in figure VI-1.

Table VI-7

Population Projections for Three Parishes, Study Area, and Morgan City to 2020

Parish	1960	2020
Assumption	17,991	30,000
Iberville	29,439	80,000
Terrebonne	60,771	210,000
Total Study Area	108,201	320,000
Morgan City	13,540	40,000



WATER SUPPLY & WATER QUALITY CONTROL STUDY
PLAQUEMINE LOCK - LOUISIANA

POPULATION TRENDS AND PROJECTIONS

U S DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
Public Health Service
REGION VII DALLAS, TEXAS

FIGURE VI-1

VII. WATER REQUIREMENTS

Water needs for municipal, industrial, and water quality control purposes in the study area are considered. Municipal and industrial water use is affected by various factors in the economy, the salient features of which are presented in the preceding chapter VI. Those elements which have influenced water use in the past serve as guides in projecting requirements for municipal and industrial purposes to the year 2020. Water quality control requirements will in turn be affected by the extent of municipal and industrial use.

Municipal

Municipal water needs include residential, public, commercial, and those industrial requirements which are served by organized public water supply systems, and are reflected in a per capita use figure. Included are distribution system losses, water use for backwashing filters, together with other treatment plant losses, and evaporation from receiving reservoirs.

Quality requirements for municipal water supplies are described in detail in Public Health Service Drinking Water Standards, 1962. 13/ These standards, in general, relate to water at the consumer's tap as contrasted with water at the source of supply, i.e., the standards apply to water after treatment.

Present Use

There are four major municipal water supply systems serving the three-parish study area and Morgan City. Table VII-1 lists pertinent data for these, together with recent water use information. (Note: A very large percentage of the population is served by public water supply systems even though in a rural area.)

Future Needs

Future municipal water need is estimated by multiplying per capita use by projected population expected to be served by public water supply systems. By 2020, per capita use is expected to average 160 gallons per day (gpd). Each of the three system service areas are expected to continue to be served by separate unrelated water supply systems. The systems in Iberville and Assumption Parishes are not expected to be affected by Intracoastal Waterway diversion. Table VII-2 presents municipal water requirements projections.

Table VII-1

Study Area Municipal Water Supply Data
Major Systems

Parish	Major Municipality	System Service Area	Est. Pop. Served	Avg. Use 1963 (mgd)	Per Capita Use (gpcd)	Source of Supply
Iberville	Plaquemine	Plaquemine	11,000	1.0	92	3 wells
Assumption	Napoleonville	Assumption Parish Water Works District No. 1	12,000	<1.0	83	Mississippi River via Bayou Lafourche
Terrebonne	Houma	Terrebonne Parish	61,000	5.5	90	Intracoastal Canal
	Morgan City	Morgan City	15,000	3.0	200	Atchafalaya River

Source: Public Health Service 14/

Table VII-2

Study Area 2020 Municipal Water Supply Requirements

Service Area	Population Served	Need (mgd)
Plaquemine	65,000	10.4
Assumption Parish	30,000	4.8
Terrebonne Parish	210,000	34
Morgan City 3/	40,000	6.5

Industrial

Industrial water requirements include the demands for water supply exerted by the principal water-using industries in the study area.

Quality requirements of industrial water-users vary over a wide range. In general, waters which are capable of being treated to meet municipal quality standards will be suitable for most industrial uses with additional treatment as required. The two predominating water-using industries, food and kindred and chemical, vary in quantity and quality requirements. Process waters (those that come in contact with or are incorporated with products) for both food and kindred products (sugar refineries), and chemicals and allied products must be at least of drinking water quality and for special uses may have higher quality requirements. However, non-process uses for chemicals and allied products, mainly cooling water, make up the major portion of requirements in this industry. Cooling water, in most situations, need not meet the exacting quality standards required for process water, although consistency of quality is desirable.

Present Use

Principal food and kindred products water need in the study area is by 8 sugar factories having an estimated present use of approximately 49 mgd during the 3-month grinding season.

Investigation revealed that the chemical plant in Iberville Parish uses approximately 350 mgd from the adjacent Mississippi River. It is estimated that approximately 10 percent of the water use at this plant is for process and sanitary purposes requiring a high quality water supply of about 35 mgd. 15/

Future Needs

Industrial water needs are expected to increase in step with projected growth in the food and kindred products, and chemicals and allied products industries.

Based on doubling food and kindred products output, projected water needs will total nearly 100 mgd; 14 mgd of which can be expected in the Houma area of Terrebonne Parish. In addition, the Morgan City area is expected to need 19.6 mgd. 3/ Needs for water for chemicals and allied products industry can be expected to grow in step with production (15-fold). Based upon once-through cooling, demands will reach 5.25 billion gallons daily (bgd) by 2020, of which 810 mgd can be expected in the coastal portion (Terrebonne Parish) of the study area, with the remainder (4.44 bgd) along and served by the Mississippi River. Approximately 81 mgd of this 2020 demand in the coastal parish will be for process water of high quality.

Demands for industrial water supply by 2020 in the Terrebonne Parish area can be expected to total 824 mgd, of which 95 mgd will be for water of high quality for process uses. These high quality water uses will require additional water supply, while cooling water needs can be served by brackish waters, which are readily available.

Water Quality Control

Analysis of need for diversion for water quality control by flow regulation is hampered by lack of flow data for the streams and canals within the study area. Each portion of the study area presents an individual situation.

Bayou Plaquemine

The Plaquemine portion of the area is expected to be oriented toward the Mississippi River with respect to waste disposal. It is anticipated that wastes (either municipal or industrial) would be permitted to be released to Bayou Plaquemine only after receiving adequate treatment. Adequate treatment is that provided by a secondary type of treatment plant, i.e., a minimum of 85 percent removal of biochemical oxygen demand (BOD). Water quality data collected by Louisiana's health and water pollution control agencies indicate current quality degradation with respect to dissolved oxygen and chlorides (see table A-2 in Appendix A). It is expected that these can be handled by adequate treatment or control at the source.

Assumption and Terrebonne Parishes

Assumption Parish wastes will be released to the marshes, Lake Verrat, and Bayou Black, while in the Terrebonne Parish, wastes will be discharged to the Intracoastal Waterway, Houma Navigation Canal, or Bayou Black. It is assumed that all wastes will be adequately treated or controlled at the source.

The water courses in the Houma (Terrebonne Parish) area are affected by the Gulf of Mexico, and flow both toward and away from the gulf. Tidal conditions have a significant effect on water quality

in this area. Care will need to be exercised in disposing of wastes as water quality degradation can take place even though adequate treatment has been provided.

Morgan City

Wastes from the Morgan City area are expected to receive adequate treatment and be disposed of properly. Under these conditions water quality problems in this area are not expected.

VIII. BENEFITS

Assuming that by the diversion of water to the Intracoastal Waterway, the need for a satisfactory municipal and industrial water supply for the Terrebonne Parish area is met, water users will benefit by having a supply of dependably better quality water than that now available.

While diversions from the Mississippi River to the Intracoastal Waterway may result in benefits to water users in the Terrebonne Parish area, recognition should be given to the potential effects of these diversions on water quality affecting sport and commercial fisheries. Diversion of the fresh, though turbid, water to the Terrebonne marsh south of the Intracoastal Waterway may be expected to increase shrimp and oyster production by offsetting salt water intrusion introduced through the Houma Navigation Canal. By not allowing these diverted waters to enter Lake Verret and Lake Palourde, sport fishing will be sustained in these lakes by protection from siltation.

Potential water users should take cognizance of the effects of the diversion route on water quality. This route, consisting of the Port Allen-Morgan City waterway and the landside channel downstream from the Bayou Sorrel Lock, together with various canals connecting to the Intracoastal Waterway in the vicinity of Houma, traverses an area of considerable sugarcane cultivation and swampy topography. Runoff from the cane fields may contain pesticides whose effects are currently under investigation and study. Runoff from the marshes and swamps is highly colored and can be expected to color the diverted water before it reaches users' intakes.

Value of Water Supply

The benefits to municipal and industrial water supply will have a value approximated by the cost of achieving the same results by the most likely alternative means that would be utilized in the absence of gravity diversion at Plaquemine or Port Allen Locks. 16/

Three alternatives were investigated: (a) Off-channel storage of water of suitable quality for use during periods of poor quality; (b) Pumped diversion of Mississippi River water to the Terrebonne Parish area via Bayou Lafourche with raw water transmission to Houma for treatment; and (c) Pumped diversion of Mississippi River water to the Terrebonne Parish area via Bayou Lafourche with finished water delivery to Houma.

All plans for alternatives lend themselves to stage construction, with each stage's cost proportional. Estimation of the cost of the first stage would reveal the most likely alternative from which the full value could be computed incorporating all stages. (Details for first stage evaluation are appended, see page B-1.)

Investigation of off-channel storage revealed the cost to be approximately 10 cents per 1,000 gallons of yield in the initial stage. Details of the cost analysis of this alternative are appended. Indications are that there would be rather insignificant economy of scale in expansion of this alternative for future needs. This area has no economically feasible sites that could be developed for storage of water in the quantities required to meet projected needs.

A study of the cost and means of diversion of Mississippi River water to Terrebonne Parish via Bayou Lafourche revealed two alternatives. The first is pumped diversion at Donaldsonville, with further pumping from Bayou Lafourche through approximately 12 miles (from Raceland) of pipe to an expanded water treatment plant at Houma to serve future needs. The cost of the long raw water transmission main makes this alternative nearly as expensive as off-channel storage. The other diversion alternative, which appears to be the least costly, would be similar to the former, but would incorporate a water treatment plant in the vicinity of Thibodaux, serving the northern portion of Terrebonne Parish with finished water on the way to Houma. (It should be noted that this area is already being served by a Terrebonne Parish water system from the Houma water treatment plant.) The existing water treatment plant will need to be expanded to meet increased demands. Expansion on Bayou Lafourche in the absence of suitable water supply at Houma is not an unreasonable alternative. Details of estimated cost of pumped diversion are appended.

Based upon pumped diversion of the Mississippi River at Donaldsonville as the most likely alternative, the value of a suitable quality municipal and industrial water supply is $148,700 annually.

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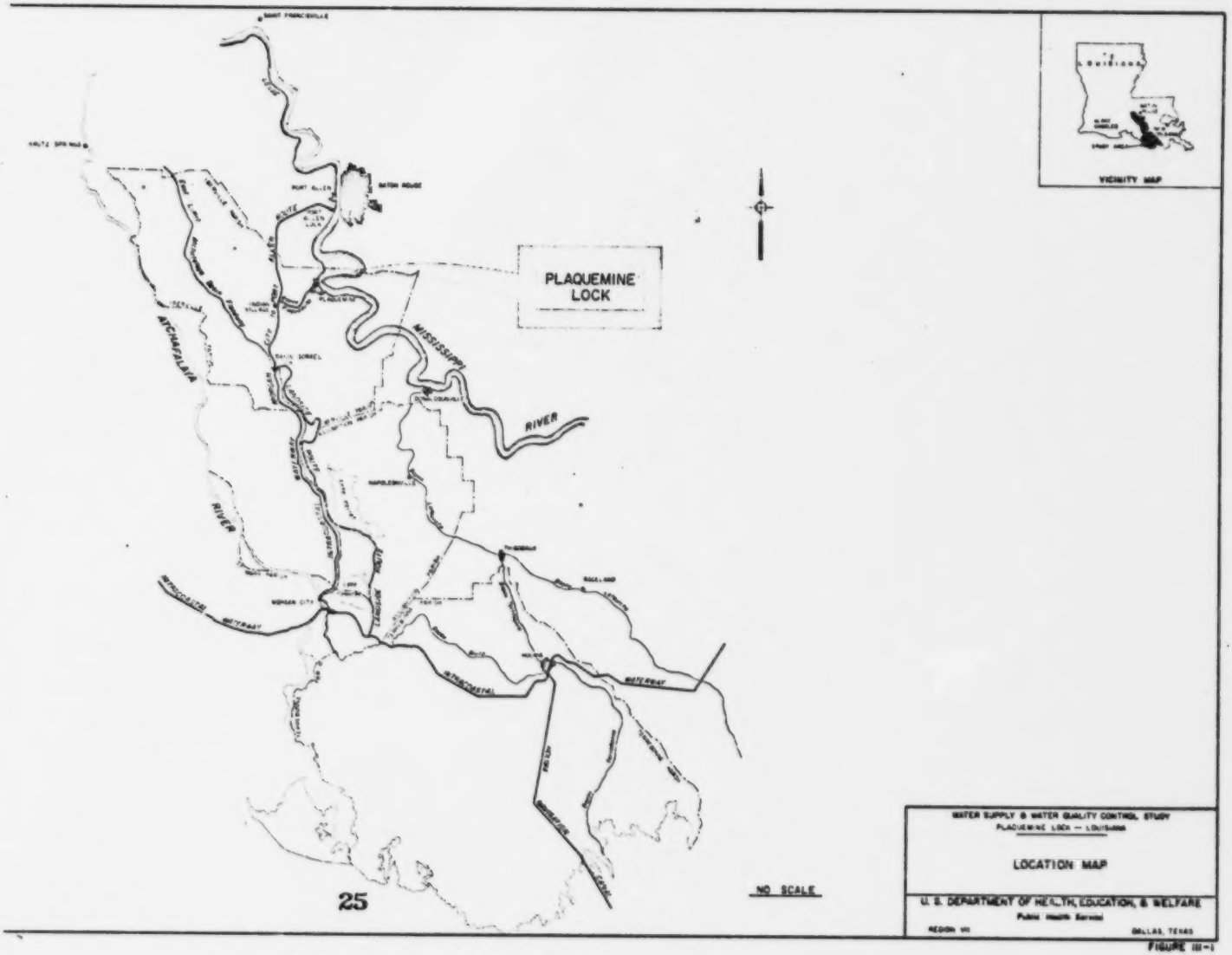
PLAQUEMINE LOCK
MISSISSIPPI RIVER
ATCHAFALAYA RIVER
INTRACOASTAL WATERWAY
VICINITY MAP
NO SCALE
WATER SUPPLY & WATER QUALITY CONTROL STUDY
PLAQUEMINE LOCK — LOUISIANA
LOCATION MAP
U. S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
Public Health Service
REGION VII
DALLAS, TEXAS

FIGURE III-1

EXHIBIT A. WATER QUALITY DATA

Table A-1

Chemical Quality - Mississippi River
Above and Below Plaquemine Lock
Water Year 1955
(mg/l)

	Fe	Ca	Mg	HCO_3	SO_4	Cl	F	NO_3	Dissolved Solids	Hardness
St. Francisville, La.										
Maximum	0.14	48	13	155	69	68	.7	6.8	304	169
Minimum	0.00	24	6.3	76	25	12	.2	2.5	156	86
Average	0.04	38	10	120	51	25	0.4	4.4	234	136
New Orleans, La.										
Maximum	0.13	49	14	157	76	64	0.6	7.3	316	176
Minimum	0.00	26	6.8	80	30	11	0.2	2.0	150	93
Average	0.03	39	11	120	52	28	0.4	4.4	239	142

Source: Geological Survey 17/

Table A-2

Water Quality - 1962-1963
Intracoastal Waterway
Port Allen-Morgan City Route

Sampling Point	Date	Dissolved Oxygen (mg/1)	pH	Total Solids (mg/1)	Hardness (mg/1)	Chlorides (mg/1)	BOD (mg/1)
Waterway Canal Below Port Allen Lock	May 1962	5.6	7.2	288	118	16.6	9
	April 1963	7.0	7.6	388	128	29	5
Waterway Canal Just upstream from Bayou Plaquemine	May 1962	4.3	7.3	392	132	71.2	1
	April 1963	7.0	7.5	378	120	34	4
Bayou Plaquemine Just East of Waterway Canal	May 1962	1.8	7.2	244	128	13.9	1
	April 1963	7.6	7.5	221	115	23	4
	Dec. 1962	9.8	8.0	-	-	106	-
	Feb. 1963	14.9	8.6	-	-	194	-
Bayou Plaquemine Just West of Lock	May 1962	5.0	7.3	301	126	56.7	1
	April 1963	7.6	7.5	209	113	16	5
	Dec. 1962	9.1	8.0	-	-	12	-
	Feb. 1963	11.8	8.0	-	-	165	-
Landside Route Just East of Bayou Sorrel Lock	May 1962	3.2	7.0	329	111	85.6	1
	April 1963	7.0	7.5	256	114	31	2

Source: Louisiana Wildlife and Fisheries Commission 18/, and Louisiana State Board of Health 19/

Table A-3

Finished Water - City of Houma, Louisiana
1961 - 1964

Date	Turbidity (Units)	pH	Color (Units)	Total Solids (mg/l)	Loss on Ignition (mg/l)	Total Alkalinity (mg/l)	Carbonate Alkalinity (mg/l)	Bicarbonate Alkalinity (mg/l)	Total Hardness (mg/l)	Chlorides (mg/l)	Carbon Dioxide (mg/l)	Iron (mg/l)	Fluoride (mg/l)	Sodium (mg/l)	Potassium (mg/l)	Manganese (mg/l)
12/6/61	2.0	8.67	30	360	81	56.0	8.0	48.0	117.4	104.3	0.0	0.15	0.9	--	--	--
10/11/61	0.0	7.90	20	415	85	40.0	0.0	40.0	115.2	157.9	1.7	0.1	0.9	--	--	--
9/13/61	0.0	9.61	10	423	134	38.0	28.0	10.0	106.0	178.6	0.0	0.0	0.7	--	--	--
8/23/61	0.0	9.62	15	264	84	28.0	20.0	8.0	84.0	91.2	0.0	0.0	0.9	--	--	--
5/17/61	2.0	9.13	15	228	85	42.0	8.0	34.0	80.0	71.3	0.0	0.3	0.6	--	--	--
3/23/61	1.0	9.67	10	222	60	28.0	20.0	8.0	86.0	61.1	0.0	0.1	0.7	--	--	--
2/22/61	0.0	9.43	10	327	100	30.0	20.0	10.0	100.0	104.6	0.0	0.0	0.8	--	--	--
1/18/61	4.0	9.28	20	446	130	41.3	20.6	20.7	116.0	166.7	0.0	0.15	1.4	--	--	--
12/5/62	5.0	8.0	5	415	68	29.3	4.9	24.4	113.1	157.4	0.0	0.05	0.8	--	--	0.0
11/18/62	2.0	8.31	20	369	145	39.0	24.4	14.6	25.1	125.3	--	0.07	0.75	--	--	0.0
10/24/62	0.0	9.0	10	354	131	34.2	19.5	14.7	106.8	118.3	0	0	0.3	--	--	0.0
8/15/62	1.0	7.62	10	324	91	44.8	10.3	34.3	104.4	101.4	0.0	0.1	0.7	--	--	0.0
9/24/62	2.0	7.99	10	345	68	41.5	4.9	36.6	104.7	109.6	0.0	0.05	0.75	--	--	0.0
7/18/62	1.0	8.46	10	391	85	50.1	5.3	44.8	102.2	131.5	0.0	0.05	0.9	--	--	0.0
6/20/62	2.0	9.26	10	255	74	34.27	21.10	13.17	82.61	80.51	0.0	0.03	0.8	--	--	0.0
4/11/62	0.0	8.89	5	173	25	47.5	15.8	31.7	87.0	50.2	0.0	0.1	1.1	--	--	0
3/28/62	1.0	8.7	5	260	45	55.0	26.2	28.8	123.9	46.5	0.0	--	1.3	--	--	0
2/14/62	1.0	8.89	15	224	67	26.0	4.0	22.0	87.0	57.8	0.0	0.08	1.0	--	--	--
1/17/62	5.0	9.45	20	270	88	50.0	4.0	46.0	106.5	55.0	0.0	0.3	1.2	--	--	--
11/19/63	29.0	9.91	15	417	116	69.3	44.7	24.6	119.1	89.4	0.0	1.0	0.2	64.1	9.6	0.15
11/6/63	2.0	7.62	15	698	114	44.7	13.4	31.3	169.1	306.4	0.0	0.0	1.0	168.0	13.3	0.0
10/23/63	3.0	8.82	10	661	175	51.4	17.9	33.5	159.3	250.9	0.0	0.05	1.40	165.5	11.7	0.0
8/14/63	0.0	8.28	15	424	144	35.3	4.7	30.6	122	140.9	0.0	0.2	1.4	--	--	0.0
7/24/63	1.0	8.93	10	339	90	33.2	19.0	14.2	105.3	106.1	0.0	0.0	0.65	--	--	0.0
6/26/63	3.0	8.51	10	283	70	28.3	9.4	18.4	90.9	84.5	0.0	0.0	0.65	--	--	0.0
5/8/63	1.0	8.55	5	253	76	34.2	4.7	29.5	95.7	73.0	0.0	0.03	1.0	--	--	0.0
4/24/63	1.0	9.0	5	238	67	23.6	18.8	4.8	86.1	55.7	0.0	0.1	0.8	--	--	0.0
3/27/63	0.0	7.55	10	366	90	40.1	4.8	35.3	119.6	116.5	0.0	0.0	1.2	--	--	0.0
1/30/63	2.0	9.40	5	375	87	43.9	34.2	9.7	166.1	165.4	0.0	0.05	0.9	--	--	0.0
5/6/64	3.0	6.11	10	238	93	29.3	0.0	29.3	109.4	52.1	13.3	0.15	0.75	55.2	3.1	0.0
4/15/64	0.0	9.12	10	229	67	41.5	24.4	17.1	106.8	48.5	0.0	0.0	0.6	--	--	0.00
4/1/64	1.0	9.49	10	240	81	39.1	24.4	14.7	106.8	46.1	0.0	0.1	0.7	--	--	0.0
2/4/64	1.0	9.58	25	319	84	44.6	25.5	19.1	122.4	70.3	--	--	0.65	46.0	7.5	0.05

Source: Louisiana State Board of Health 20/

Table A-4

Water Quality - Above Black near Vidalia, Louisiana, 1958-1963

Date	pH	Temp °C	Dissolved Oxygen (mg/l)	Total Alkalinity as $CaCO_3$ (mg/l)	Total Hardness as $CaCO_3$ (mg/l)	Turbidity (Units)	Spec Cond (micro-mho/cm) at 25°C	Color (Units)	Chlorides as Cl (mg/l)	Sodium as Na (mg/l)	Potassium (mg/l)
June 1-15, 1958	7.9	29.0	7.0	95.0	111.6	<25	184.6	20.0	18.7	28.0	3.0
June 16-30, 1958	--	--	--	--	--	--	--	--	--	--	--
July 1-15, 1958	--	28.0	4.6	86.0	94.6	30	183.7	100.0	19.4	--	--
July 16-31, 1958	--	27.0	6.6	56.0	68.8	<30	149.5	80.0	16.4	8.0	3.0
Aug 1-15, 1958	7.0	27.0	2.2	90.6	100.0	<31	139.8	80.0	13.1	8.0	2.6
Aug 16-31, 1958	7.1	28.0	6.6	92.6	111.2	<32	401.9	20.0	53.6	--	--
Sept 1-15, 1958	6.2	25.0	2.9	68.0	62.0	<60	--	110.0	6.3	6.3	3.7
Sept 16-30, 1958	5.8	25.0	2.2	60.0	39.2	<32	--	110.0	5.7	7.5	6.2
Oct 1-15, 1958	6.8	22.0	2.2	60.0	60.0	<28	--	120.0	6.3	9.5	3.0
Oct 16-31, 1958	--	--	--	--	--	--	--	--	--	--	--
Nov 1-15, 1958	--	--	--	--	--	--	--	--	--	--	--
Nov 16-30, 1958	--	--	--	--	--	--	--	--	--	--	--
Dec 1-15, 1958	--	--	--	--	--	--	--	--	--	--	--
Dec 16-31, 1958	--	--	--	--	--	--	--	--	--	--	--
Jan 1959	--	--	--	--	--	--	--	--	--	--	--
Feb 1959	7.3	15.5	2.5	51.0	71.3	30	233	137.5	30	52	9
Mar 1959	6.7	16	3.3	36.1	99.2	30	192	120	20.7	39.5	7.2
Apr 1959	7.3	20	2.8	2.8	76	12.5	362	110	36.5	56.2	8
May 1959	8.0	22	6	81.8	100	30	636	30	26.5	84.5	9.3
Jun. 1959	7.0	25	6	58	63.2	30	189	30	13.3	20	10.5
Jul. 1959	6.8	27	2	30	36	30	96	30	9.7	15	6
Aug. 1959	8.4	28	1.8	53	59.2	85	183	85	9.1	20	3
Sep. 1959	6.8	28	2	62	62	130	96	130	16.5	12	3.2
Oct. 1959	6.8	26	3	61	51.2	120	105	120	16	21	4.5
Nov. 1959	--	--	--	--	--	--	--	--	--	--	--
Dec. 1959	--	--	--	--	--	--	--	--	--	--	--
Jan 1960	--	--	--	--	--	--	--	--	--	--	--
Feb 1960	6.8	10	3.6	32	37.8	40	170	90	25.2	21	4.7
Mar 1960	6.6	11	2.0	29	42.6	<35	--	105	26.0	23	4.8
Apr 1960	7.6	17	2.2	56.6	63.6	<35	218	105	26.2	26	5.5
May 1960	7.1	20	3.0	70	91.6	<35	401	65	32.6	30	3.7
June 1960	7.6	26	7.0	106	136.0	40	482	20	56.2	36	3.7
July 1960	7.9	30	5.0	105	174.6	<30	656	20	63.6	31	3.3
Aug. 1960	7.3	30	1.2	98	137.6	<30	480	25	66.9	60	6.5
Sep 1960	7.2	28	1.6	90	93.6	<30	357	330	19.8	12	2.5
Oct 1960	7.2	25	1.8	78	104.6	<30	381	125	52.1	--	4.0
Nov 1960	7.5	18	2.6	62	60.6	<30	226	280	34.2	21	2.1
Dec. 1960	7.0	13	2.2	65.2	101.2	<30	313	240	66.1	25	2.7
Jan 1961	7.5	7	2.4	47	85.2	<30	300	280	42.8	22	3.4
Feb 1961	7.6	13	8.0	28	66.8	<25	165	120	21.9	12	2.2
Mar 1961	7.8	15	2.0	28	41.6	<30	136.1	160	17.1	8	2.5
Apr 1961	8.1	16	2.0	81	53.2	30	161.2	160	12.8	9	2.0
May 1961	7.2	22	2.0	45	68.2	30	212	120	27.6	16	2.5
Jun 1961	7.2	23	6.6	72.6	109.2	155	487.2	25	23.6	16.5	3.0
Jul 1961	6.8	26	2.0	35.0	94	<30	119.9	125	11.6	7	1.6
Aug 1961	7.0	28	2.2	42	113.6	<30	137.0	90	13.9	10	2.0
Sep 1961	7.0	27	1.8	33.0	43.2	<30	141	100	13.6	8.5	4
Oct 1961	7.6	23	1.4	52	90.8	<30	178	120	16.3	19	2.9
Nov 1961	7.4	21	1.0	6	101.2	30	191	30	24	38	4.2
Dec. 1961	7.6	14	2.0	53.8	64.8	<30	269.5	110	27.5	18	2.8
Jan 1962	6.7	6	3.0	40	65.2	<30	161.3	80	20.0	11	1.9
Feb 1962	7.0	11	2.8	36	60	30	138.9	110	20.5	14	2.0
Mar 1962	--	--	--	--	--	--	--	--	--	--	--
Apr 1962	7.9	12	8.0	71	101	45	366	20	16.5	14	7.1
May 1962	7.3	21	6.4	58	74	120	249.3	20	20.3	18	3.1
Jun 1962	7.4	26	5.0	69	116	35	349	35	34.2	34	3.7
Jul 1962	6.9	25	2.0	60	72	60	182	60	19.6	16	3.6
Aug 1962	7.5	29	2.4	87	131	<30	466.3	60	101.0	59	5.5
Sep 1962	7.6	28	3.6	112	192	<30	348	30	102	45	4.8
Oct. 1962	7.2	24	3.6	114	136	<30	430	35	174	62	4.9
Nov 1962	7.8	17	6.0	112	162	30	438.6	25	80.9	63	5.0
Dec. 1962	7.4	13	7.4	108	167	45	411	25	109.2	76	4.9
Jan 1963	7.8	10.0	3.2	86.0	142.0	12	336.0	120.0	60.6	58.0	4.3
Feb 1963	7.2	10.0	4.0	70.0	126.0	110	471.0	150.0	70.6	38.0	3.0
Mar 1963	6.6	12.0	3.0	35.0	84.0	30	415.0	120.0	51.2	23.0	3.0
Apr 1963	7.5	19.0	7.0	77.0	125.2	45	479.0	70.0	63.0	33.0	2.5
May 1963	7.2	22.0	7.0	95.0	137.0	<30	630.0	75.0	84.5	50.0	2.8
Jun 1963	8.0	25.0	6.8	103.0	142.0	<30	588.0	25.0	65.0	45.0	2.9
Jul. 1963	7.9	27.0	4.6	85.0	111.0	<30	492.0	80.0	68.0	29.0	3.0
Aug. 1963	7.6	28.0	3.6	102.0	139.0	<30	592.0	35.0	80.0	60.0	3.5
Sep. 1963	7.2	29.0	3.0	110.0	136.0	<25	614.0	50.0	100.0	63.0	3.5
Oct. 1963	7.3	23.0	3.6	80.0	100.0	<30	493.0	120.0	48.5	36.0	3.5
Nov. 1963	7.7	17.0	6.0	117.0	126.0	45	688.0	25.0	150.0	90.0	4.3
Dec. 1963	6.9	13.0	2.0	76.0	120.0	35	336.0	100.0	47.0	25.0	2.5

Source: Louisiana Stream Control Commission 21/

Table A-5

Water Quality - Bayou Sorrelhouse at Bruce, Louisiana, 1958-1963

Date	pH	Temp °C	Dissolved Oxygen (mg/l)	Total Alkalinity as $CaCO_3$, (mg/l)	Total Hardness as $CaCO_3$ (mg/l)	Turbidity (Units)	Spec. Cond. (micro-mhos/cm) at 25°C	Color (Units)	Chlorides as Cl (mg/l)	Sodium as Na (mg/l)	Potassium (mg/l)
June 1-15, 1958	--	28.0	3.0	109.8	110.0	20	238.0	70.0	10.9	11.0	3.0
June 16-30, 1958	--	--	--	--	--	--	--	--	--	--	--
July 1-15, 1958	--	26.0	5.1	152.0	153.6	30	401.9	55.0	315.0	--	--
July 16-31, 1958	--	26.0	2.9	93.2	96.8	37	257.2	80.0	15.7	8.9	4.9
Aug. 1-15, 1958	7.2	27.0	2.2	96.0	98.0	30	292.3	85.0	51.2	18.0	5.0
Aug. 16-31, 1958	7.4	26.0	2.6	118.4	118.4	31	306.2	80.0	16.2	--	--
Sep. 1-15, 1958	6.6	25.0	2.2	96.0	99.6	30	--	90.0	5.9	12.5	6.6
Sep. 16-30, 1958	--	--	--	--	--	--	--	--	--	--	--
Oct. 1-15, 1958	7.6	22.0	3.0	82.0	86.0	20	--	95.0	5.1	9.0	3.9
Oct. 16-31, 1958	--	--	--	--	--	--	--	--	--	--	--
Nov. 1-15, 1958	--	--	--	--	--	--	--	--	--	--	--
Nov. 16-30, 1958	--	--	--	--	--	--	--	--	--	--	--
Dec. 1-15, 1958	--	--	--	--	--	--	--	--	--	--	--
Dec. 16-31, 1958	--	--	--	--	--	--	--	--	--	--	--
Jan. 1959	--	--	--	--	--	--	--	--	--	--	--
Feb 1959	7.5	16.0	2.5	96.0	135.6	<30	52.7	100.0	27.3	62.0	13.0
Mar 1959	7.1	16.5	3.3	77.0	104.8	55	362.0	95.0	9.8	42.0	11.0
Apr 1959	7.6	19.5	4.4	102.0	202.2	35	75.2	75.0	33.3	61.5	9.5
May 1959	8.1	25.0	1.6	130.0	130.2	65	498.0	65.0	26.0	97.5	9.0
Jun 1959	7.5	23.0	3.5	66.0	62.8	35	122.0	25.0	5.6	18.0	11.0
Jul 1959	--	26.0	1.8	76.8	87.2	<30	225.0	20.0	8.7	21.0	9.0
Aug 1959	7.8	28.0	2.0	106.8	109.2	<30	275.0	90.0	14.5	21.0	6.0
Sep 1959	7.2	28.0	1.0	109.0	116.8	<30	234.0	70.0	10.5	26.0	7.0
Oct 1959	8.6	26.0	2.0	153.0	136.0	<30	391.0	50.0	65.6	57.0	7.5
Nov 1959	--	--	--	--	--	--	--	--	--	--	--
Dec 1959	--	--	--	--	--	--	--	--	--	--	--
Jan 1960	--	--	--	--	--	--	--	--	--	--	--
Feb 1960	7.0	12	2.6	85	106.0	40	253	75	17.5	20	10.0
Mar 1960	7.4	15	1.0	114	129.6	40	--	80	23.0	26	10
Apr 1960	7.6	19	2.6	98.4	112.4	45	212	65	11.2	17	8
May 1960	7.9	18	1.4	122	126.0	40	336	65	21.4	23	9.5
Jun 1960	7.3	27	0.8	109	140.8	30	344	25	81.6	54	5
Jul 1960	7.6	29	2.0	97	136.8	30	320	30	85.8	52	6.5
Aug 1960	7.6	30	2.4	106	129.6	30	408	20	52.1	36	5
Sep 1960	8.1	27	4.0	120	140	30	433	40	20.3	11	5
Oct 1960	7.6	23	2.2	141	180.4	30	433	40	86.6	--	--
Nov. 1960	7.5	20	4.4	103	16.2	30	376	30	73.4	40	6.5
Dec. 1960	7.2	11	3.0	106.0	118	30	1,140	20	209.3	135	7.1
Jan 1961	8.0	9.0	2.0	140.0	140.0	40	336.0	80.0	35.2	25.0	7.5
Feb 1961	7.9	8.0	5.2	84.0	173.2	3	433.0	60.0	21.7	19.0	9.7
Mar 1961	8.0	16.0	1.4	56.0	136.0	<30	263.8	120.0	13.1	7.0	5.4
Apr 1961	8.0	17.0	1.8	78.0	105.2	40	214.0	40.0	5.5	8.0	4.0
May 1961	7.2	24.0	2.0	66.0	111.6	50	306.0	140.0	18.0	13.0	7.0
Jun 1961	7.5	27.0	4.6	126.0	140.4	<30	274.4	40.0	43.6	30.0	7.0
Jul 1961	7.1	27.0	1.6	78.0	91.2	<30	235.5	100.0	18.2	10.0	5.4
Aug 1961	7.3	28.0	2.0	94.0	41.2	40	412.0	100.0	34.6	14.0	5.0
Sep 1961	7.9	26.0	2.0	112.0	129.6	30	290.0	60.0	23.4	14.0	6.0
Oct 1961	7.6	24.0	1.8	78.0	86.0	40	225.0	60.0	14.8	12.0	6.5
Nov 1961	7.1	21.5	2.8	94.0	572.0	40	4,125.0	50.0	1,953.0	350.0	80.0
Dec 1961	7.6	15.0	2.6	98.0	100.8	<30	268.0	70.0	26.0	11.0	6.2
Jan 1962	7.0	9.0	3.6	84.0	118.0	<30	322.0	80.0	20.5	12.0	6.0
Feb 1962	7.2	14.0	2.0	110.0	140.0	40	348.0	40.0	25.0	14.0	6.0
Mar 1962	7.7	15.0	2.6	124.0	147.0	<30	370.0	70.0	44.0	27.0	6.0
Apr 1962	7.8	15.0	3.6	110.0	130.0	30	434.0	80.0	38.0	15.0	6.0
May 1962	7.3	23.0	2.4	82.0	96.0	30	322.0	120.0	24.9	8.0	5.5
Jun 1962	7.3	27.0	2.6	86.0	122.0	<30	444.0	80.0	46.3	5.0	4.5
Jul 1962	7.2	26.0	3.0	118.0	118.0	20	330.0	40.0	32.5	23.0	5.3
Aug 1962	7.4	30.0	3.6	110.0	146.0	<30	390.0	50.0	106.0	45.0	6.8
Sep 1962	8.1	28.0	2.0	110.0	150.0	<30	1,080.0	20.0	265.0	114.0	7.4
Oct 1962	7.5	23.0	3.0	112.0	260.0	45	1,222.0	80.0	430.0	231.0	12.0
Nov 1962	7.5	18.0	3.5	102.0	255.0	<30	1,490.2	20.0	417.2	230.0	12.1
Dec 1962	7.5	14.0	3.4	104.0	220.0	35	1,340.0	25.0	268.4	140.0	9.0
Jan 1963	7.3	11.0	3.2	100.0	90.0	30	410.0	30.0	108.0	70.0	7.0
Feb 1963	7.3	13.0	4.6	102.0	240.0	<30	960.0	50.0	48.0	33.0	6.0
Mar 1963	6.8	14.0	8.0	88.0	272.0	<30	634.0	50.0	33.0	22.0	5.0
Apr 1963	7.2	21.0	4.6	102.0	188.0	<25	640.0	80.0	112.0	44.0	5.4
May 1963	6.6	22.0	1.2	82.0	130.0	<30	480.0	80.0	58.0	32.0	5.0
Jun 1963	7.9	25.0	2.5	95.0	137.0	30	588.0	25.0	70.5	45.0	5.0
Jul 1963	8.5	27.0	8.0	137.0	154.0	<30	640.0	30.0	29.0	19.0	5.0
Aug 1963	7.5	29.0	2.8	114.0	115.0	30	512.0	35.0	43.0	34.0	4.0
Sep 1963	6.9	30.0	1.6	100.0	138.0	35	528.0	60.0	121.0	17.0	3.5
Oct 1963	7.2	24	1.0	129	228	180	1,092	70	229	135	4.5
Nov 1963	7.5	19	4.0	115	621	45	1,800	25	1,450	600	12.4
Dec 1963	7.4	13.5	1.5	118	232	50	640	35	65.0	24	8.0

Source: Louisiana Stream Control Commission 2/

Table A-6

Chemical Quality - Atchafalaya River
at Krotz Springs, Louisiana
Water Year 1955
(mg/l)

	Fe	Ca	Mg	HCO_3	SO_4	Cl	F	NO_3	Dissolved Solids	Hardness
Maximum	0.23	56	16	158	80	165	-	5.6	448	206
Minimum	0.00	23	5.2	73	22	15	-	1.5	158	79
Average	0.08	37	9.4	108	46	53	-	3.3	265	131

Source: Geological Survey 17/

EXHIBIT B. BENEFITS EVALUATION

B-1

Evaluation of Alternatives

I. Assumed Water Supply Plan

A. 2020 requirements for municipal and industrial process use - 129 mgd

1965 Municipal and industrial use - 12.5 mgd

Expected use growth rate 4 3/4% annually (double in 15 years)

B. Develop in three stages

1. 1970 - 30 mgd yield - total available - 30 mgd
   (use at time of addition - 16 mgd)
2. 1980 - add 35 mgd - total available - 65 mgd
   (use at time of addition - 25 mgd)
3. 2000 - add 65 mgd - total available - 130 mgd
   (use at time of addition - 62 mgd)

II. Estimated First Stage Development Cost

A. Off-channel storage

1. Need 4-month (120 days) storage

2. 30 mgd x 120 days x 3.07 acre-ft./mg = 11,050 acre-feet

3. $\frac{11,050 \text{ acre-feet}}{9 \text{ ft. (avg. depth)}}$ = 1,230 acres

Say 1,300 acres required

4. Estimated Cost

a. Land $200/acre [22] x 1,300 acres = $ 260,000

b. Construction Cost

Dredging (9 ft.) 20.5¢/yd^3 [23]
x 17,827,000 yd^3 = 3,650,000

c. Line to Water Plant $88,000
Pumps 65,000 [24]
Utilities Alteration 50,000
Control Structure 72,000 [24]

Total fixed costs	= $ 275,000
Engineering & Contingencies (15 percent)	589,000
	$4,774,000

5. Annual Cost

a. Amortizacion (25 years @ 4%)

$4,774,000 x 0.06412 = $ 306,109

b. Operation & Maintenance

(1% of Capital Cost) 47,740

$ 353,849/yr.

c. Raw Water Cost (off-channel storage)

$\frac{\$353,849}{3,600 \text{ mg}}$ = $0.098/1,000 gallons

B. Pumped Diversion from Mississippi River at Donaldsonville to Bayou Lafourche with raw water transmission to Houma

1. Cost of 30 mgd pump station @ river

3 - 10 mgd (50 hp) units plus 1 spare* (1.s) = $ 325,000 [24/]

2. Cost of 30 mgd pump station @ Raceland

3 - 10 mgd (110 hp) units plus 1 spare* (1.s.)=$ 130,000 [24/]

3. 54" pipeline from Raceland to Houma - 12 miles

12 miles x $250,000/mile* = $3,000,000

$3,455,000

4. Annual Cost

a. Amortization (25 years @ 4%)

$3,455,000 x 0.06412 = $ 221,535

b. Operation & Maintenance = 48,000

$269,535/yr.

*Includes costs of land, right-of-way, engineering and contingencies.

C. **Pumped Diversion from Mississippi River at Donaldsonville to Bayou Lafourche with treatment plant at Thibodaux and transmission of treated water to the Terrebonne Parish system.**

1. Cost of 30 mgd pump station @ river*

   (l.s.) = $325,000 [24/]

2. Average Annual Cost

   a. Amortization on $325,000 x 0.06412 = $20,840

   b. Operation & Maintenance = 24,160

   ∴ Most likely alternative $45,000/yr.

Value of Benefits

A. Supplying 130 mgd as shown in Assumed Water Supply Plan

1. 1st Step - 1970

   30 mgd (40 mgd incl. spare with appropriate structure - to provide 130 mgd in 2020)
   No discounting = $1,250,000* [24/]

2. 2nd Step - 1980

   35 mgd - discount 10 yrs. @ 4%
   $200,000* [24/] x 0.67556 = 135,000

3. 3rd Step - 2000

   65 mgd - discount 30 yrs. @ 4%
   $350,000* [24/] x 0.308319 = 107,900
   $1,492,900

   a. Amortization 25 yrs. @ 4%

      0.06412 x $1,492,900 $95,700

   b. Operation & Maintenance
      Average for 50 years 53,000/yr

   c. Total Value $ 148,700

*Includes costs of land, right-of-way, engineering and contingencies.